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“Inland Agile Port”

Ladies and gentlemen, it is with great pleasure that I accepted the invitation to come here to America to this conference and I'm proud to give my presentation under this famous roof of your national academies. I'm here representing Noel Crane Systems which is a German company and which is part of the Fantuzzi Reggiane Group which is the biggest supplier of crane-handling equipment worldwide.

The subject of my presentation is two-fold: first, to reassure academia that promising concepts like the Agile Port System, are technologically feasible; and second, to report in more detail about the inland agile port which is an issue in Germany for years already.

On the major containerized trade routes, container shipping is growing by 6-8% per year <Fig. 2>. What does it mean for the container ports? Here you see a diagram showing key figures of European container ports in the Northwest range which means Belgium, Netherlands, and Germany <Fig. 3>. The upper part of the table shows existing terminals. Now, we see that the Delta Terminal of Rotterdam is in terms of throughput per meter quay, the most advanced. They have about 800 TEU per year and meter quay. If you look at the throughput per crane, that is about 155,000 TEU per year and crane. That is in the Port of Antwerp. But, now it is interesting to see that in Europe, two new modern container terminals are under construction – one is in Hamburg, the Altenwerder Terminal, and one is in Antwerp, the Left Bank Terminal. The outcome is that they plan to double throughput per meter quay, which means they are trying to achieve 1,400 TEU per year and meter quay. Then we see on the other hand, the throughput per crane in TEU per year remains about the same. This shows that not the crane is the bottleneck today, but that they want to optimize their yard operations. Thus need number one in marine terminals, is rising yard productivity by keeping quay crane productivity.

How do they do that? Here we have the type of quay cranes which will be installed in the Port of Antwerp at the left and in Hamburg on the right side <Fig. 4>. On the left-hand side, this is a picture of the biggest cranes in the world, an average outreach of 66 meters. On the right-hand side, we have a two-trolley quay crane.

What is the technology for the horizontal transport? The automatic vehicle on the right-hand side is an AGV system which has to be loaded by the crane and on the left-hand side, this kind of equipment will be installed in Antwerp – a straddle carrier type of vehicle to travel between the quay cranes and the stacking cranes <Fig. 5>.

Then we have the automatic stacking technology. In Hamburg they will have a gantry crane system, and on the right-hand side this shows the type of crane they are going to install in Antwerp, an overhead crane type stacking crane <Fig. 6>.

These components of the container terminal are the basis for an agile container handling system.

Need number two : Major container ports will have to reduce dwell times of ultra-large container vessels <Fig. 7>.

Just imagine, you cannot put more than 6-7 ship-to-shore cranes at the side of such a big ship. On average, such a container crane is able to do 35 moves per hour. So, if you have seven of these cranes, you make 245 moves per hour and ship. If you want to maximize this, you have to have another type of crane. This kind of crane will have several trolleys in order to make parallel actions. We have investigated three different types of multi-trolley cranes and compared them to a conventional crane and you can see a two-trolley type like it is installed in Hamburg already – has a 1/3 better performance. If you have two trolleys which are penetrating each other-one may go through the other-then you have about a 2/3 better performance to expect. Then at the far right, this is a three trolley crane where you have two trolleys for the lifting and one horizontal transport trolley. This is the answer to need number two – reducing dwell times of ultra large vessels <Fig. 8>.

Need number three is reducing highway congestion <Fig. 9>. And need number four is shifting container storage capacity inland <Fig. 10>. The storage capacities required ashore are exploding. The answer to both is the Agile Port System which was presented two speakers before: Splitting the marine terminal into two parts in an Efficient Marine Terminal ashore and an Intermodal Interface Center inland, both connected by a dedicated freight corridor <Fig. 11>.

You've seen ideas before how such an Efficient Marine Terminal may look like. This is a competing idea <Fig. 12>. It is the first time that you are able technologically to load and unload rail cars directly at the quay. The reason why it is possible is that you do not have to move the quay crane in parallel to the ship because then you have lost. What is absolutely necessary is that the quay crane concentrates on the bay which it is digging in. So, as soon as it is leaving it, the performance will drop down. So, what is done here – we separate the loading process between vessels and container train. So, this big gantry crane looks almost like the one installed in Hamburg having got an intermediate platform. The container unloaded from the ship is just put on the platform and then again the seaside trolley on the quay crane will concentrate on the next container. Meanwhile, the container put on the platform will be conveyed a step sideward. Here, a rail-mounted gantry which is traveling between the legs of the ship-to-shore crane will serve this platform and put the container directly on the train, or if there is no slot, will put it on the sorting facility. So, if there is no slot, it puts it on the sorting facility with a number of independent shuttle cars. These are able to go to the right and left side and go forward and backward by just turning the wheels by 90 degrees. I hope I have a chance to show you a film where you will see that.

This picture shows the sorting facility which you absolutely need because of the synchronization between the loading process on the train and on the vessel.

The Inland Interface Center is a subject we are dealing with for years already in Germany <Fig. 13>. There was a competition about five years ago among the leading industries and the German Railways wanted to have a system which replaces a shunting yard. A shunting yard is a very time-consuming facility and the idea is that the containers will be transshipped between trains instead. Trains are coming from source terminals somewhere. These may be also marine terminals and as soon as the containers will be landed, they will be loaded on trains no matter which destination they are bound for. Then they go to a central knot, the Intermodal Interface Center, and there the load will be consolidated between the trains so that trains with loads for only one unique destination or relation will leave the hub.

How does it look like? We have an area of only about 80 meters times 700 meters. 700 meters is the maximum length of the trains in Europe. You can enter with up to six trains in here. They will come in a time distance of eight minutes. So, at time zero the first train comes in, after eight minutes the second, after sixteen minutes the third, and so on. So, after 40 minutes, all 6 trains are in and they are all together in about 20 minutes, and then leave every eight minutes. So, within 100 minutes, you can interchange the loads of all 6 trains which are about 360 containers to be moved between the trains within 100 minutes.

This is another view <Fig. 14>. Here you see the rails for the freight trains. Again, here you see the sorting facility. Of course the gantry crane tries first to transship directly between trains. But, if the free place is not within its reach, it puts the box on the sorting facility, the box being transported in parallel to the trains, to another gantry crane, and then will be loaded on the target destination on the outgoing train.

This is such a wagon photographed on our demonstration plant in Würzburg. You can see this is just a frame of steel on wheels. Quite stupid, which is very necessary with respect to maintenance. It cannot be stupid enough. Then, how is it propelled? You have magnetic strips under the rail carriage and in the runway linear motors. They contain wires and you put an electrical circuit to it and there will be produced an electromagnetic force and it just propels the wagon forward, backward, left or right. What you can do is position this wagon up to three millimeters exact. This is ideal for all automatic functions between cranes and for horizontal transport vehicles <Fig. 15>.

This is the outcome of the simulation: The worst case is that you have these 360 load units to be transshipped between trains within 100 minutes. Therefore we need 10 cranes and 40 linear motor-driven wagons. But, if you only have 320 load units, how many cranes do you need then? That is eight and you need 32 of these linear motor-driven wagons. So, you have a relation of four wagons to one crane <Fig. 16>.

The maximum performance of the sorting facility was verified by a detailed simulation. There was a PhD thesis from the University of Hanover and it took the gentleman about 2.5 years just to model it in detail. There are certain layers of modeling and the outcome was that it is possible to sort 360 containers in 100 minutes.

This is the main advantage of this mega-hub in comparison with the shunting yard. This is the time spent in the shunting yard in order to service six trains with 40 wagons and each having 60 containers on top. You are interested in when will the first train leave again the shunting yard? It takes at least five hours and twenty minutes. If you go into such a mega-hub where you transship which is a parallel process, up to 10 cranes can transship in parallel from one train to the other instead of shunting wagons one after the other. So, there is only one hour and ten minutes which is very necessary for us in Europe because that means that we gain three hours from trucks <Fig. 17>.

Then here – the space requirement. Because a shunting yard is a thing which is very long, you have to get the trains in, you have to push them across the hill, and you have to sort them in another portion behind and at the end you have to put all the trains together again. It is about 5-7 kilometers long. So, we would not be able to find places anymore in Germany to install a shunting yard in order to form a hub and spoke system <Fig. 18>.

The first Intermodal Interface Center should have been built already. The discussions going on for more than five years already. It was already on the list for the world exhibition Expo 2002 in Hanover. Then the German Railways were privatized and nobody felt any more responsible for innovations. But, we are quite sure that in the next year, a step forward will be made in order to install this in Germany. All parties agree being involved in the private operation <Fig. 19>.

So, just to summarize the advantages of the Agile Port System. By implementing the Agile Port System, land shortage ashore as well as road congestion belong to the past. All parts of the split marine terminal are each highly space economic, and are connected by a dedicated railway line. Each part of the EMT and IIC combines gantry cranes with the highly efficient box mover. The efficient marine terminal allows for the loading and unloading of trains next to the quay cranes, and sorting of containers in the Intermodal Interface Center is four times faster than in shunting yards <Fig. 20>.

Now, I'm going to show you a movie how that works in the IIC (MegaHub).
(VIDEO)

That brought me to the end of my presentation. I thank you very much and I just want to let you know that we are a German company and that we have an U.S. American subsidiary. Due to the incidents of the 11th of September the chair was kind enough to give Noell the opportunity for another short presentation dealing with a straddle-carrier based x-ray system. I give the podium to Michael B. Krupp, a colleague of mine. Thank you very much for your attention.